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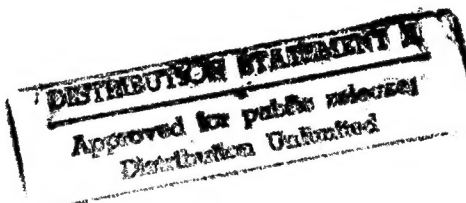
Compost Resampling Results at Umatilla Depot Activity, Hermiston, Oregon

Report Number: SFIM-AEC-ET-CR-95021

Contract Number: DACA31-91-D-0079

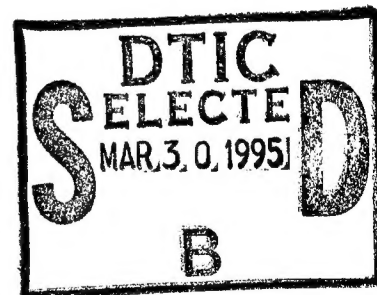
Task Order Number: 0001

February 1995



Prepared for:

U.S. Army Environmental Center (USAEC)
SFIM-AEC-ETD
Aberdeen Proving Ground, MD 21010-5401



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REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188	
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1. AGENCY USE ONLY (Leave Blank)		2. REPORT DATE February 1995	5. REPORT TYPE AND DATES COVERED May 1994 - February 1995
4. TITLE AND SUBTITLE Compost Resampling Results at Umatilla Depot Activity, Hermiston, Oregon		8. FUNDING NUMBERS	
6. AUTHOR(S) J. O. Hammell, W. L. Lowe			
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9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESSES(ES) U. S. Army Environmental Center SFIM-AEC-ETD Aberdeen Proving Ground, MD 21010-5401		10. SPONSORING/MONITORING AGENCY REPORT NUMBER SFIM-AEC-ET-CR-95021	
11. SUPPLEMENTARY NOTES Project Officer: Mark Hampton (410) 612-6852			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unlimited Local Reproduction Encouraged		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Previous field demonstrations conducted by the U.S. Army Environmental Center (USAEC) have shown that composting can be an effective bioremediation technology for explosives - contaminated soils. Finished compost exhibits extensive reductions in extractable explosives as well as in toxicity compared to the starting materials. USAEC has now conducted testing to evaluate potential long-term changes in compost characteristics, such as my result following redispersion of finished compost. Finished compost from a previous field demonstration was analyzed for extractable explosives, leachable explosives and TNT intermediates (using USEPA's Multiple Extraction Procedure), and extractable nitrate/nitrite. Low levels of extractable explosives were observed in resampled compost consistent with samples from the end of the compost operation. Extractable explosives in the Multiple Extraction Procedure generally declined with successive extractions. As would be expected for organic compost material, detectable nitrate/nitrite concentrations were present in all samples.			
14. SUBJECT TERMS Explosives, Composting, Bioremediation, Windrow, TNT, RDX, HMX, DNT		15. NUMBER OF PAGES 27 - Text 9 - Appendices	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

COMPOST RESAMPLING RESULTS
AT UMATILLA DEPOT ACTIVITY
HERMISTON, OREGON

Report No: SFIM-AEC-ET-CR-95021
Contract No. DACA31-91-D-0079
Task Order No. 01

February 1995

Prepared for:

U.S. Army Environmental Center (USAEC)
SFIM-AEC-TSD
Aberdeen Proving Ground, MD 21010-5401

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SECTION 1

INTRODUCTION

The U.S. Army Environmental Center (USAEC) conducted field scale demonstrations of composting for explosives-contaminated soils at Umatilla Depot Activity (UMDA) to establish composting as a bioremediation technology^(1,2). Analytical data from these and previous composting tests have shown that composting effectively reduces extractable levels of nitroaromatic and nitramine explosives to low levels^(1,2,3). In addition, extensive reduction in leachable explosives, as measured by the U. S. Environmental Protection Agency's (USEPA's) Toxicity Characteristic Leading Procedure (TCLP) and/or Synthetic Precipitation Leaching Procedure (SPLP) tests, as well as reductions in toxicity have been achieved in the compost process in these pilot scale demonstrations^(4,5). The data upon which these observations were based represented the composted soils mixture at the end of the treatment process.

USAEC has now conducted additional testing to evaluate potential long-term changes in compost characteristics, such as may result following disposition or redisposal of the treated material. This was accomplished by returning to the UMDA test site and sampling finished composts which had been stored on site following the most recent field demonstration⁽²⁾ approximately 18 months earlier. These finished compost samples were analyzed for the following groups of parameters:

- Extractable explosives, including 2,4,6-trinitrotoluene (TNT), 1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), hexahydro-1,3,5-trinitro-1,3,4-triazine (RDX), 1,3,5-trinitrobenzene (TNB), 2,4-dinitrotoluene (2,4-DNT), and 2,6-dinitrotoluene (2,6-DNT), and selected TNT intermediates, for comparison to final compost data from the field trial;
- Leachable explosives and TNT intermediates using a modification of USEPA's Multiple Extraction Procedure, to assess the potential for release of target constituents under long-term leaching as may occur under landfill disposal conditions. The modification to the Multiple Extraction Procedure consisted of the use of the SPLP extraction method rather than the EP

Toxicity (EPTOX) method, based upon previous work by Oak Ridge National Laboratory (ORNL);

- Extractable nitrate/nitrite, to assess the potential for release of these constituents from the finished compost (derived not only, or necessarily, from the explosives, but also from the organic amendments used in the composting process).

This report summarizes the results of the compost resampling effort.

SECTION 2

MATERIALS AND METHODS

At the end of the specific tests during windrow composting demonstration⁽²⁾, finished composts were stored onsite in polyethylene "envelopes", in a storage bin adjacent to the test area (see Figure 2-1). Composts from individual tests were segregated from one another (in separate envelopes) in anticipation of the desire to resample the materials following long-term storage. The compost storage envelopes were covered with high density polyethylene (HPDE) for containment. The storage bin was intended to hold composts from both previous UMDA demonstration projects^(1,2) pending further treatment/disposition during the full-scale washout lagoon remediation project. The storage bin was not intentionally configured to simulate compost disposal conditions (rather, to provide interim storage). The nature of the envelope would likely result in anoxic conditions within the finished compost.

A site visit was made in May 1994 for the purpose of (among other activities) resampling the stored compost residuals. A trip report from the resampling visit is presented as Appendix A. The resampling effort was conducted under an approved Statement of Work (SOW)⁽⁶⁾ and an Addendum to the Windrow Composting Demonstration Site Test Plan⁽⁷⁾ and the Site Safety and Health Plan (SSHP)⁽⁸⁾. In accordance with the SOW, the following samples were taken:

- CWR7 - Finished compost from the aerated windrow to evaluate the previously noted analytical parameters.
- CWR8 - Finished compost from the unaerated windrow to evaluate the previously noted analytical parameters.
- Seed C - Finished compost from sequence C (control) of the Seed (Recycle) Compost Test program⁽²⁾. Since final sample data from the windrow tests (CWR7 and CWR8) showed very low levels of target analytes, this sample was selected to provide one sample from a compost which exhibited significant levels of explosives at the time they were placed into storage.

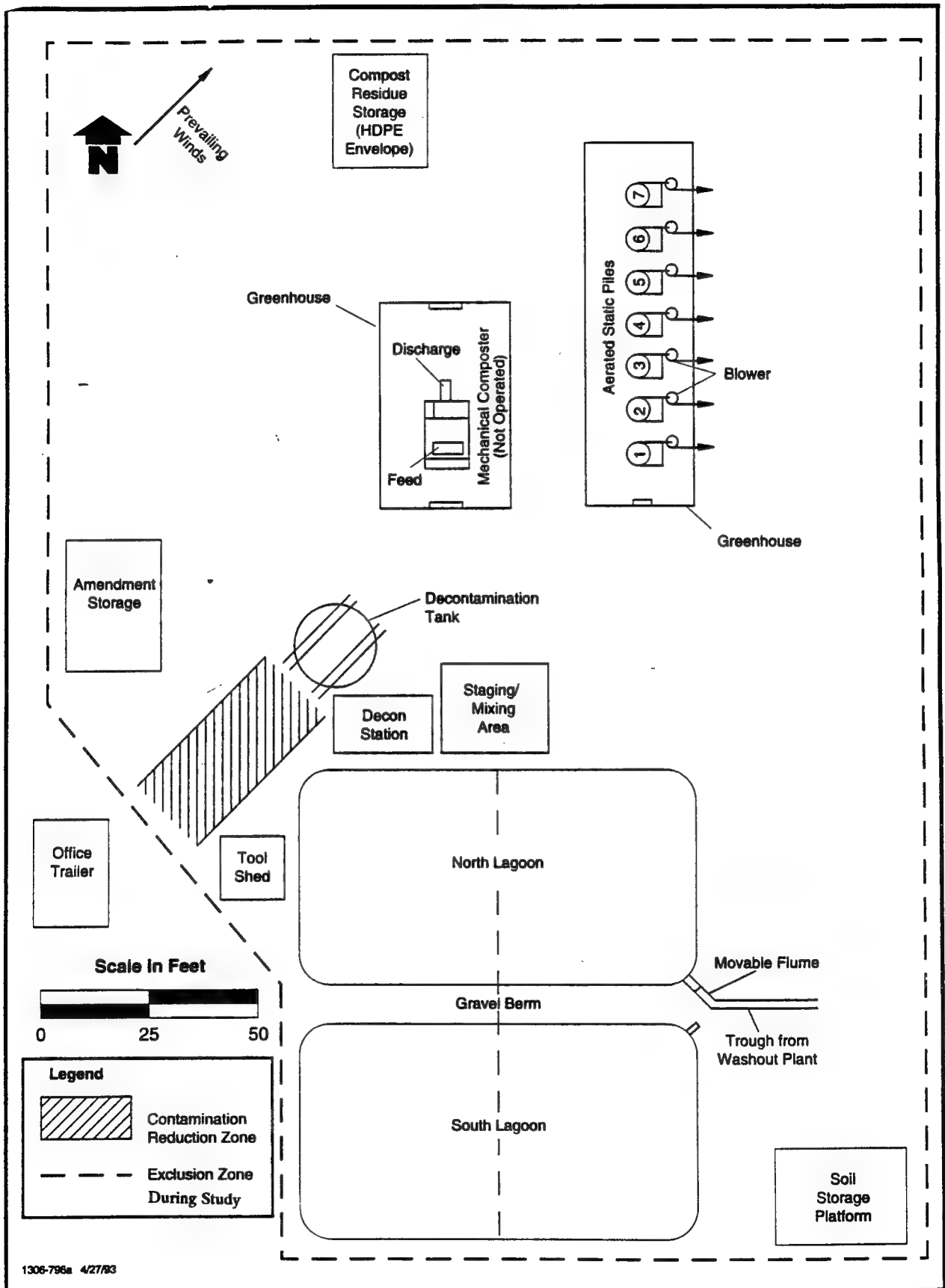


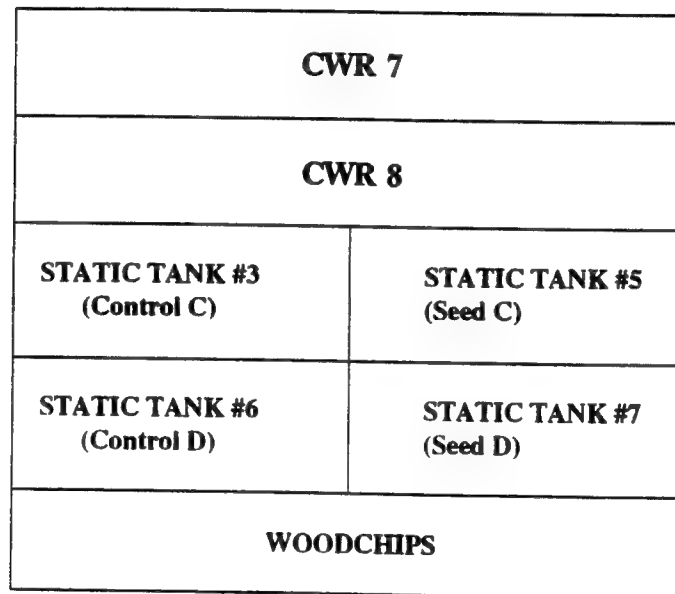
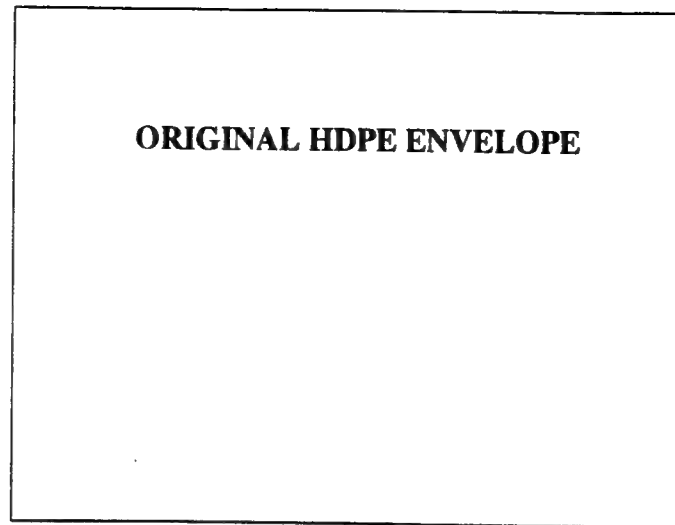
FIGURE 2-1 SEEDING STUDY SITE LAYOUT

The location of the various compost portions within the HDPE bin, as determined at the site visit Appendix A) is shown in Figure 2-2.

After air monitoring using a Combustible Gas Indicator, the plastic cover over the compost was removed. As specified in the test plan addendum⁽⁷⁾, representative samples were collected for analysis from each of the specified envelopes (CWR7, CWR8, and Seed C). Samples were placed in jars, packed in ice in coolers, and shipped with appropriate chain-of-custody forms to WESTON's Lionville Laboratory.

Samples were analyzed for explosives and TNT intermediates using USEPA Method 8330 as previously modified for analysis of compost⁽²⁾. This method quantifies explosive compounds and TNT intermediates. The monoaminodinitrotoluene isomers coelute and are reported as "total aminodinitrotoluenes". Samples were oven dried at 60°C for 12 hours⁽⁹⁾. The dried samples were milled in a Wiley mill to produce a homogenous product for extraction and analysis⁽¹⁰⁾.

Leaching of degradation products (explosives and intermediates) was conducted on "as received" samples by USEPA Method 1320, Multiple Extraction Procedure. Milling and drying was not conducted so that the leaching was conducted on materials as they would actually be redispersed. The SOW⁽⁶⁾ specified using a modification to Method 1320 previously used by Oak Ridge National Laboratory (ORNL). Discussions with ORNL indicated that the specified ORNL modification consisted of a reduction in sample volume to facilitate ¹⁴C-TNT testing (not required for this work) and modification of the first extraction step from the USEPA Method 1310, EP Toxicity procedure as specified in Method 1320, to USEPA Method 1312, Synthetic Precipitation Leading Procedure (SPLP), Appendix B, extraction to simulate land redispersion of compost. After discussions with USAEC it was determined that only the latter of these modifications was appropriate for this task. In the Multiple Extraction Procedure nine successive extractions (following an initial extraction by the EP Toxicity method) are performed, followed by analysis of each of the extracts. According to the method, if the concentration of the constituent of concern



PLAN VIEW OF NEW HDPE ENVELOPE

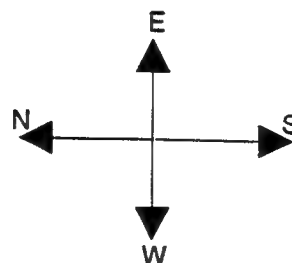


FIGURE 2-2 LOCATION OF VARIOUS COMPOST PORTIONS WITHIN THE HDPE BIN

increases from the seventh or eighth to the ninth successive extraction, the procedure is repeated until extract concentrations decrease. For purposes of this testing, however, it was determined to perform only the specified nine extractions⁽⁶⁾.

Nitrate/nitrite leachability testing was conducted using U.S. EPA Method 353.1 (modified to replace nitric acid in the leaching solution with sulfuric acid, to the same solution pH value) followed by nitrite/nitrate analysis of leachates by U.S. EPA Method 3531. The rationale for deletion of nitric acid was to avoid interference with the nitrate analysis.

SECTION 3

RESULTS

Table 3-1 shows the milled composting analytical results for explosives and intermediates, and pH. The concentrations of explosives and intermediates on the final day of the specific tests during composting field demonstration, as presented in the final report⁽²⁾ are also included in Table 3-1, for comparison with the data following this long-term storage period. As was expected, explosive and intermediate concentrations after storage were very low for the windrow compost samples. This corresponds to the observed destruction of these compounds during the windrow composting demonstration.

In general, the explosives and intermediates concentrations were lower in the resampled compost than in the compost analyzed on the final day of composting. This may be indicative of continued biodegradation in the compost. With the exception of the aerated windrow (CWR7), for samples which exhibited an increase in concentration (principally HMX and RDX), the resampled concentrations lie within the standard deviation of the final day sampling results. The reason for the CWR7 results is not apparent. Samples from the final day of the compost demonstration were originally analyzed for explosives by USATHAMA Method LW02. Previous method comparisons between Method LW02 and U.S. EPA Method 8330 extractions⁽²⁾ have shown that LW02 extractions (used on the final compost analysis) reflect a consistently low bias in comparison to U.S. EPA Method 8330 extractions (used for compost reanalysis). The differences in extraction methodology further complicates comparison of the results. Values for Seed Reactor C tended to be somewhat higher than for the windrows, particularly with respect to HMX and RDX concentrations. As noted in the field demonstration project report⁽²⁾, the seed reactors were generally less effective in explosives removals, particularly for HMX and RDX, than were the windrows.

Compost pH values were measured at the time of analysis in order to assess whether changes in pH with storage occurred and whether such changes appeared to be correlated with any changes in explosives parameters. The data in Table 2-1 show minor changes in

Table 3-1

Milled Compost Explosives/Intermediate Results

Compound	CWR7 ^{1,4}		CWR8 ^{2,4}		Seed C	
	Resampling	Final Day ^(3,6)	Resampling	Final Day ^(3,6)	Resampling	Final Day ⁽³⁾
2,4,6-Trinitrotoluene (mg/kg)	0.20 U	2.76 ± 3.09	1.10	13.57 ± 28.48	6.4	13.55 ± 7.0
RDX (mg/kg)	7.0	1.10 ± 0.41	1.80	5.37 ± 11.64	745	466 ± 390.1
HMX (mg/kg)	14.0	6.84 ± 1.7	1.70 U	1.47 ± 0.66	340	233.6 ± 52.8
1,3,5-Trinitrobenzene (mg/kg)	0.24	2.07 ± 0.09	0.27	2.09 ± 0.02	0.85	2.13 ± 0.06
2,6-Dinitrotoluene (mg/kg)	0.19 U	0.40 ± 0.02	0.21 U	0.40 ± 0.00	0.20 U	0.41 ± 0.01
2,4-Dinitrotoluene (mg/kg)	0.00012 U	0.42 ± 0.02	0.20 U	0.42 ± 0.00	0.19 U	0.43 ± 0.01
2,4-diamino-6-nitrotoluene (mg/kg)	0.19 U	2.54 ± 0.03	0.20 U	2.58 ± 0.05	0.19 U	NA
2,6-diamino-4-nitrotoluene (mg/kg)	0.19 U	2.54 ± 0.03	0.20 U	2.55 ± 0.05	0.19 U	NA
Amino-DNTs (mg/kg) ⁵	5.60	6.91 ⁶	0.20 U	6.34 ⁶	9.20	NA
pH (Standard units)	8	8.8	8.7	8.4	8	8.6

¹ Aerated Windrow² Un-aerated Windrow³ Data from final day of specified compost test during field demonstration⁽²⁾.⁴ Intermediates analyzed, day 40 of composting; explosives and pH analyzed day 53 of composting.⁵ Sum of 4-amino-2,6-dinitrotoluene and 2-amino-4,6-dinitrotoluene.⁶ Standard deviations for the sum is not available since original data was individually reported for 4-amino-2,6-dinitrotoluene and 2-amino-4,6-dinitrotoluene.

Notes:

U = Analyzed, Not Detected. Value reported is the minimum detection limit for the sample.

B = Analyte was found in the associated blank as well as in the sample.

NA = Not Analyzed.

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pH with long-term storage, with decreases in two cases (CWR7, and Seed C) and a slight increase in CWR8. No obvious correlation between pH changes and explosives levels is apparent.

Tables 3-2, 3-3 and 3-4 show the original leachate and subsequent extract concentrations for compost from CWR7, CWR8 and Seed Reactor C, respectively. In general, extract concentrations were low, even in the original leachate. The highest compost explosives concentrations were generally found in Seed Reactor C (Table 3-1), and these samples also had the highest leachate concentrations. This is particularly evident for HMX and RDX concentrations. The highest concentrations of TNT, HMX and RDX observed in Seed compost leachate or extracts were .025, 6.8, and 26 mg/L, respectively. The highest concentrations of TNT, HMX, and RDX in the windrow compost extract and leachates were 0.00051, 1.30, and 0.150 mg/L, respectively. In general, the extract concentrations declined with subsequent extractions. In a number of cases, values were at or below detection limits in the original extract and no declining trend is observed. These data are demonstrated graphically for each of the analyzed compounds in Figure 3-1 through 3-9. Values below the detection limit ("U" values) were graphed as one half of the detection limit value. In cases where three distinct lines (CWR7, CWR8, and Seed C) are not evident, the values of two or more trials are so closely matched that the lines are superimposed. In a few instances, apparent increases in selected analytes were observed in the last extractions. In general, increases were not observed for all analytes in a particular compost. In some cases the immediately preceding samples were below detection limits. As noted previously, this analytical program was limited to the method-specified minimum of nine extractions. Original leachate concentrations are compared to the leachate concentrations determined on the final day of composting in Table 3-5. No obvious trends are noted between the two data sets primarily due to the higher detection limits present in the original SPLP testing.

Table 3-2

Compost Resample Results
Multiple Extraction Test
Aerated Windrow (CWR7)

Compound	Original Leachate	Extraction #1	Extraction #2	Extraction #3	Extraction #4	Extraction #5	Extraction #6	Extraction #7	Extraction #8	Extraction #9
2,4-Diamino-6-Nitrotoluene (mg/L)	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
2,6-Diamino-4-Nitrotoluene (mg/L)	0.00012 U	0.00012 U	0.00012 U	0.00071	0.0003	0.00016	0.00012 U	0.00012 U	3.2	0.00012 U
HMX (mg/L)	1.30	0.220	0.042	0.027	0.014	0.0092	0.0046	0.0032	0.0049	0.0037
RDX (mg/L)	0.150	0.160	0.002	0.0014	0.002	0.00077	0.00047	0.00078	0.0016	0.001
1,3,5-Trinitrobenzene (mg/L)	0.00054 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U
Amino-DNTs (mg/L)	0.00061	0.024	0.0094	0.011	0.0095	0.0096	0.011	0.0096	0.0089	0.0095
2,4,6-Trinitrotoluene (mg/L)	0.00013	0.021	0.0042	0.0026	0.0035	0.0026	0.00013 U	0.00013 U	0.00013 U	0.0034
2,6-Dinitrotoluene (mg/L)	0.0006	0.00083	0.00079	0.00042	0.00084	0.00013	0.00013 U	0.00013 U	0.00013 U	0.00013 U
2,4-Dinitrotoluene (mg/L)	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Nitrate/Nitrite (mg-N/L)	25	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH (Standard units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

U = Analyzed, Not Detected. Value reported is the minimum detection limit for the sample (not the method detection limit).
B = Analyte was found in the associated blank as well as in the sample.

Table 3-3
Composting Resample Results
Multiple Extraction Test
Un-aerated (CWR8)

Compound	Original Leachate	Extraction #1	Extraction #2	Extraction #3	Extraction #4	Extraction #5	Extraction #6	Extraction #7	Extraction #8	Extraction #9
2,4-Diamino-6-Nitrotoluene (mg/L)	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
2,6-Diamino-4-Nitrotoluene (mg/L)	0.00037	0.00012 U	0.00012 U	0.00023	0.0003	0.0007	0.00039	0.52	0.49	0.00012 U
HMX (mg/L)	0.0013	0.0054	0.0018	0.0026	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U
RDX (mg/L)	0.0063	0.0052	0.012	0.0026	0.00054 U	0.00054 U	0.00054 U	0.00054 U	0.00054 U	0.00054 U
1,3,5-Trinitrobenzene (mg/L)	0.00054 U	0.00013 U	0.00012	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U
Amino-DNTs (mg/L)	0.0011	0.00088	0.0007	0.001	0.0011	0.0012	0.0001	0.0011	0.0015	0.0021
2,4,6-Trinitrotoluene (mg/L)	0.00051	0.0021	0.00066	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00061
2,6-Dinitrotoluene (mg/L)	0.00048	0.00035	0.00053	0.00019	0.00038	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U
2,4-Dinitrotoluene (mg/L)	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Nitrate/Nitrite (mg-N/L)	7.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH (Standard units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

U = Analyzed, Not Detected. Value reported is the minimum detection limit for the sample (not the method detection limit).
B = Analyte was found in the associated blank as well as in the sample.

Table 3-4

Compost Resample Results
Multiple Extraction Test
Seed C

Compound	Original Leachate	Extraction #1	Extraction #2	Extraction #3	Extraction #4	Extraction #5	Extraction #6	Extraction #7	Extraction #8	Extraction #9
2,4-Diamino-6-Nitrotoluene (mg/L)	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.31	0.61	1.6	0.72	0.00012 U
2,6-Diamino-4-Nitrotoluene (mg/L)	0.00012 U	0.0042	0.0042	0.0063	0.0032	0.0022	0.0011	0.0031	0.0025	0.00012 U
HMX (mg/L)	6.800	3.600	3.200	2.000	0.800	0.350	0.21	0.15	0.094	0.072
RDX (mg/L)	26.000	4.600	1.300	0.520	0.300	0.096	0.062	0.047	0.027	0.030
1,3,5-Trinitrobenzene (mg/L)	0.00026	0.00038 B	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U
Amino-DNTs (mg/L)	0.230	0.120	0.071	0.070	0.054	0.048	0.053	0.058	0.049	0.082
2,4,6-Trinitrotoluene (mg/L)	0.025	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U
2,6-Dinitrotoluene (mg/L)	0.0011	0.00081	0.00059	0.0019	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U
2,4-Dinitrotoluene (mg/L)	0.00057	0.00018	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Nitrate/Nitrite (mg-N/L)	22.1 MG N/L	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH (Standard units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

U = Analyzed, Not Detected. Value reported is the minimum detection limit for the sample (not the method detection limit).
B = Analyte was found in the associated blank as well as in the sample.

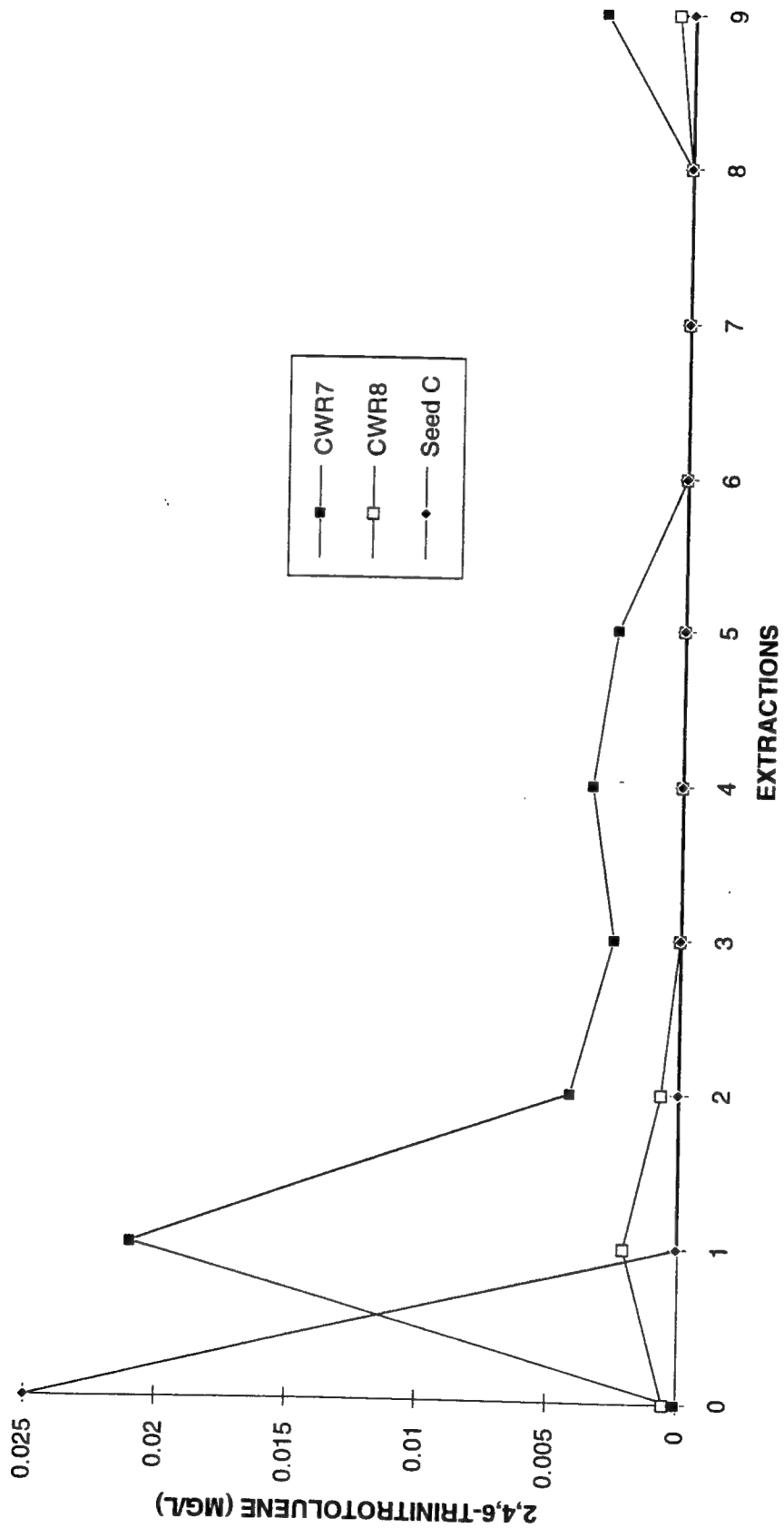


FIGURE 3-1 - 2,4,6-TRINITROTOLUENE RESAMPLING RESULTS

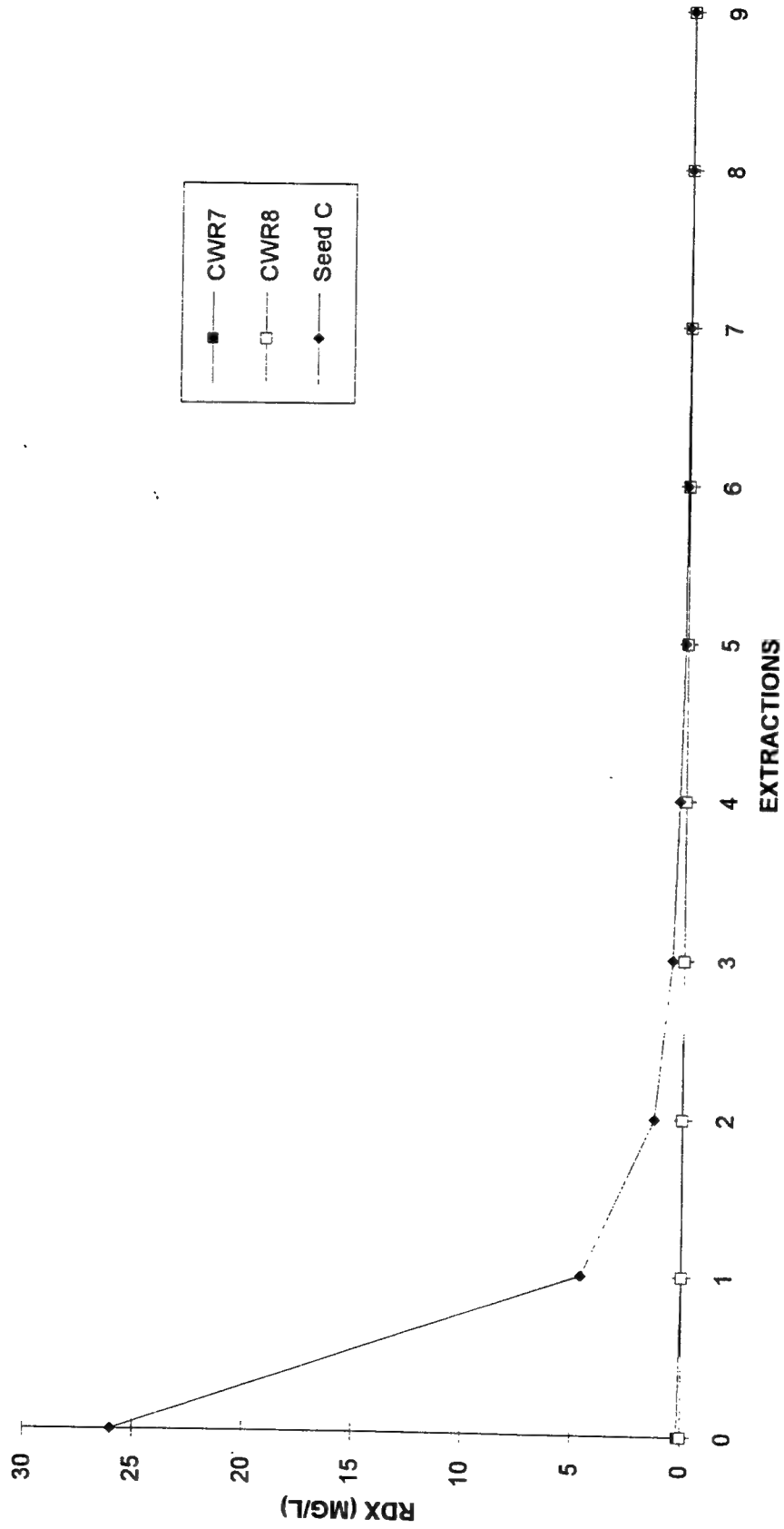


FIGURE 3-2 - RDX RESAMPLING RESULTS

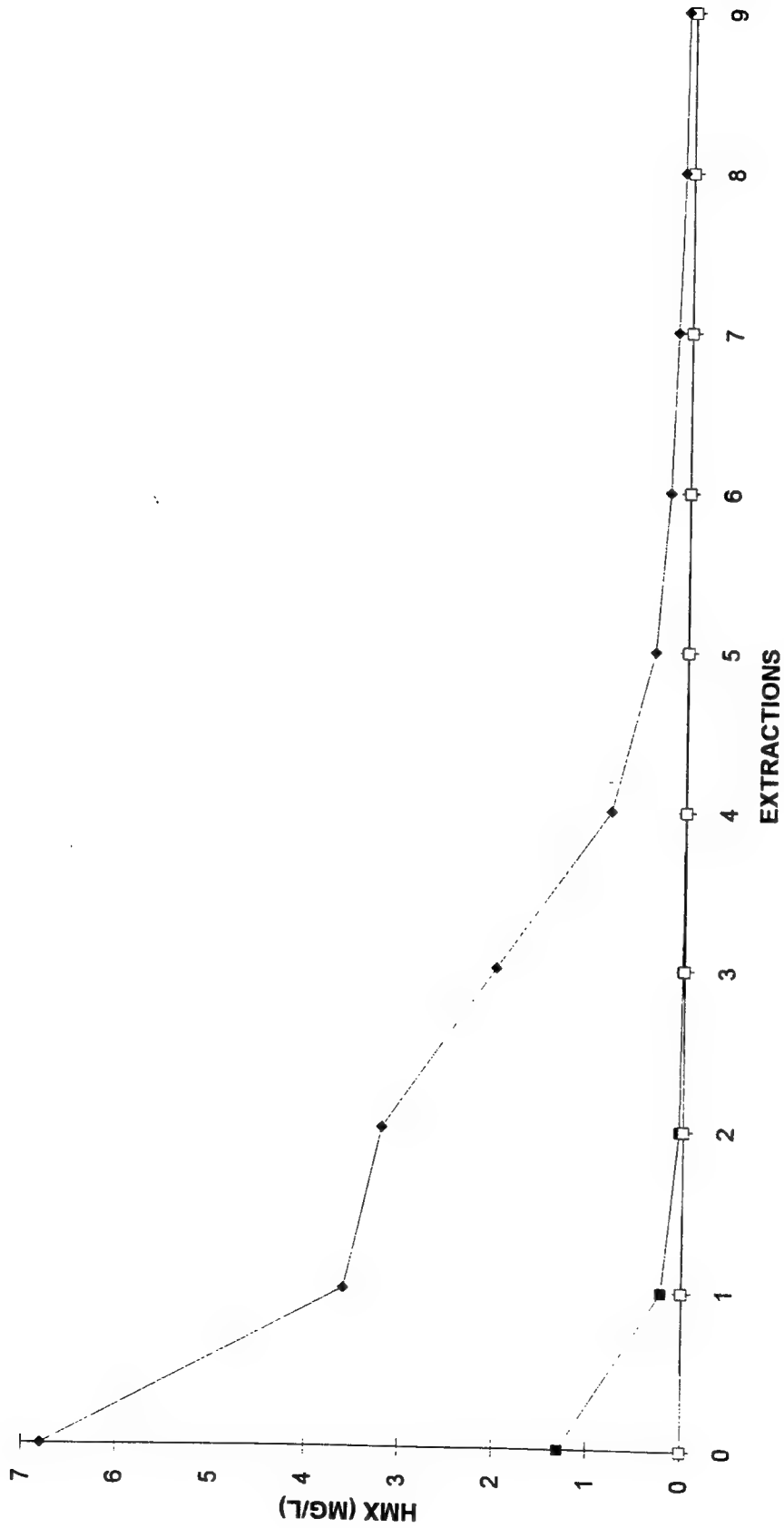


FIGURE 3-3 - HMX RESAMPLING RESULTS

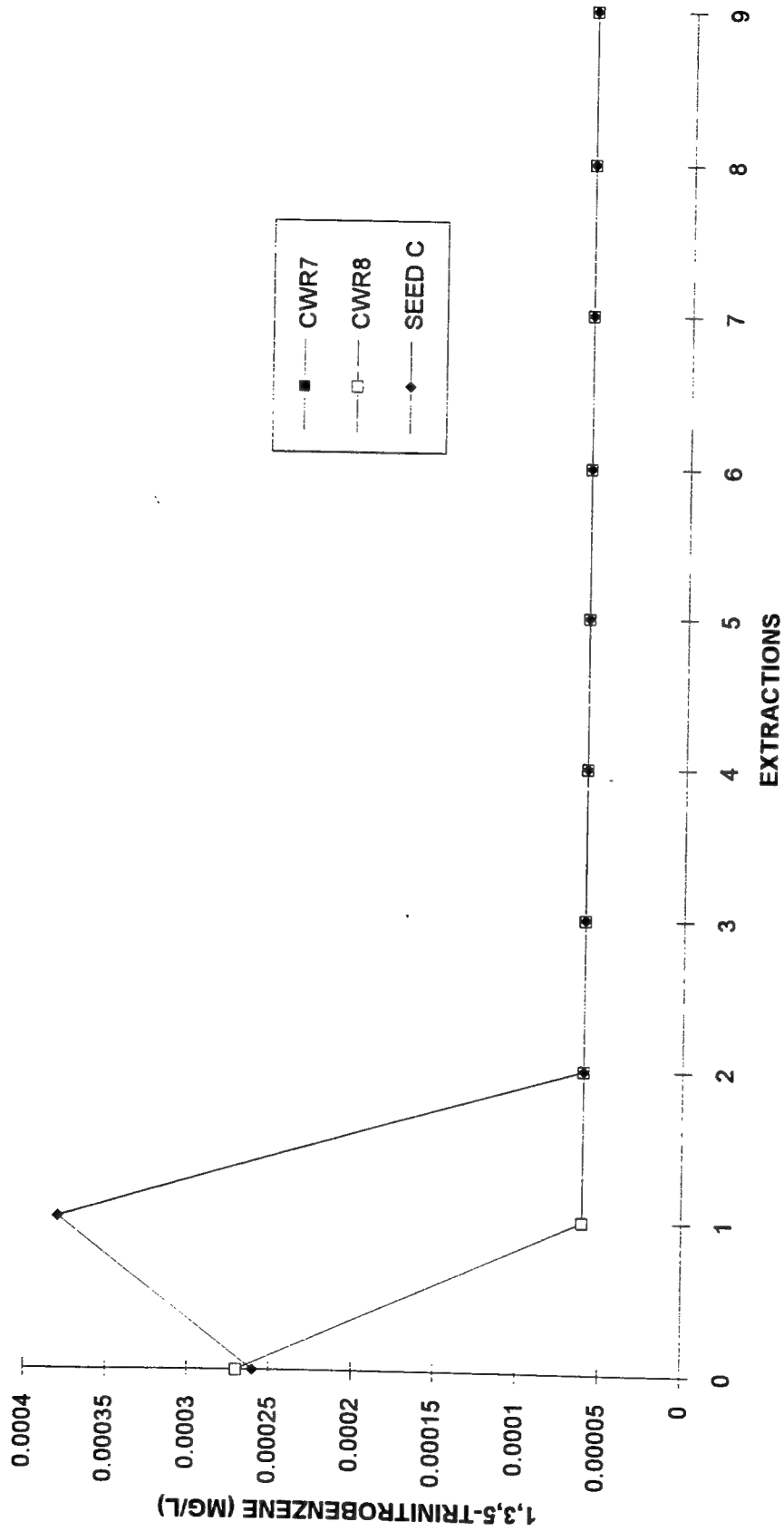


FIGURE 3-4 - 1,3,5-TRINITROBENZENE RESAMPLING RESULTS

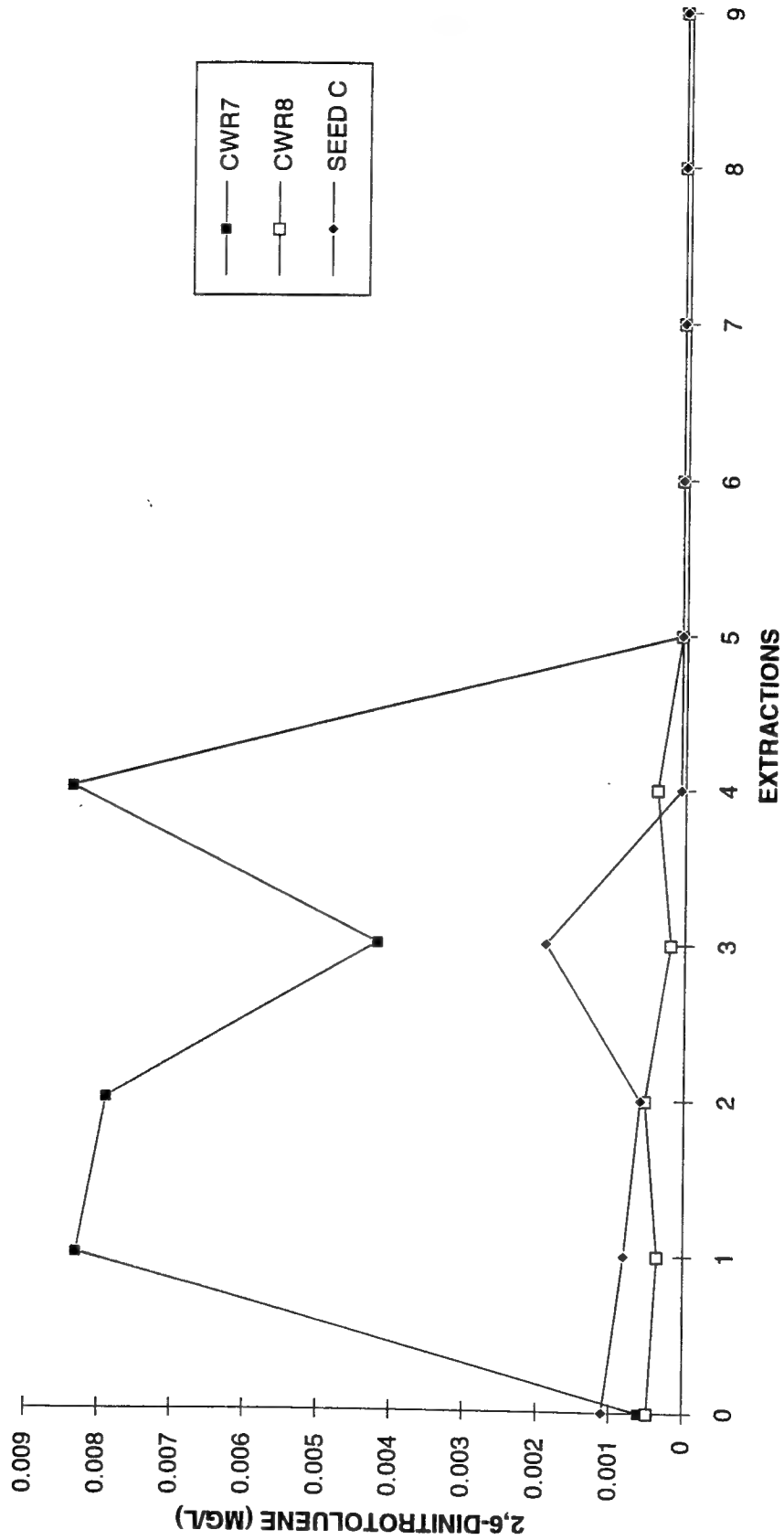


FIGURE 3-5 - 2,6-DINITROTOLUENE RESAMPLING RESULTS

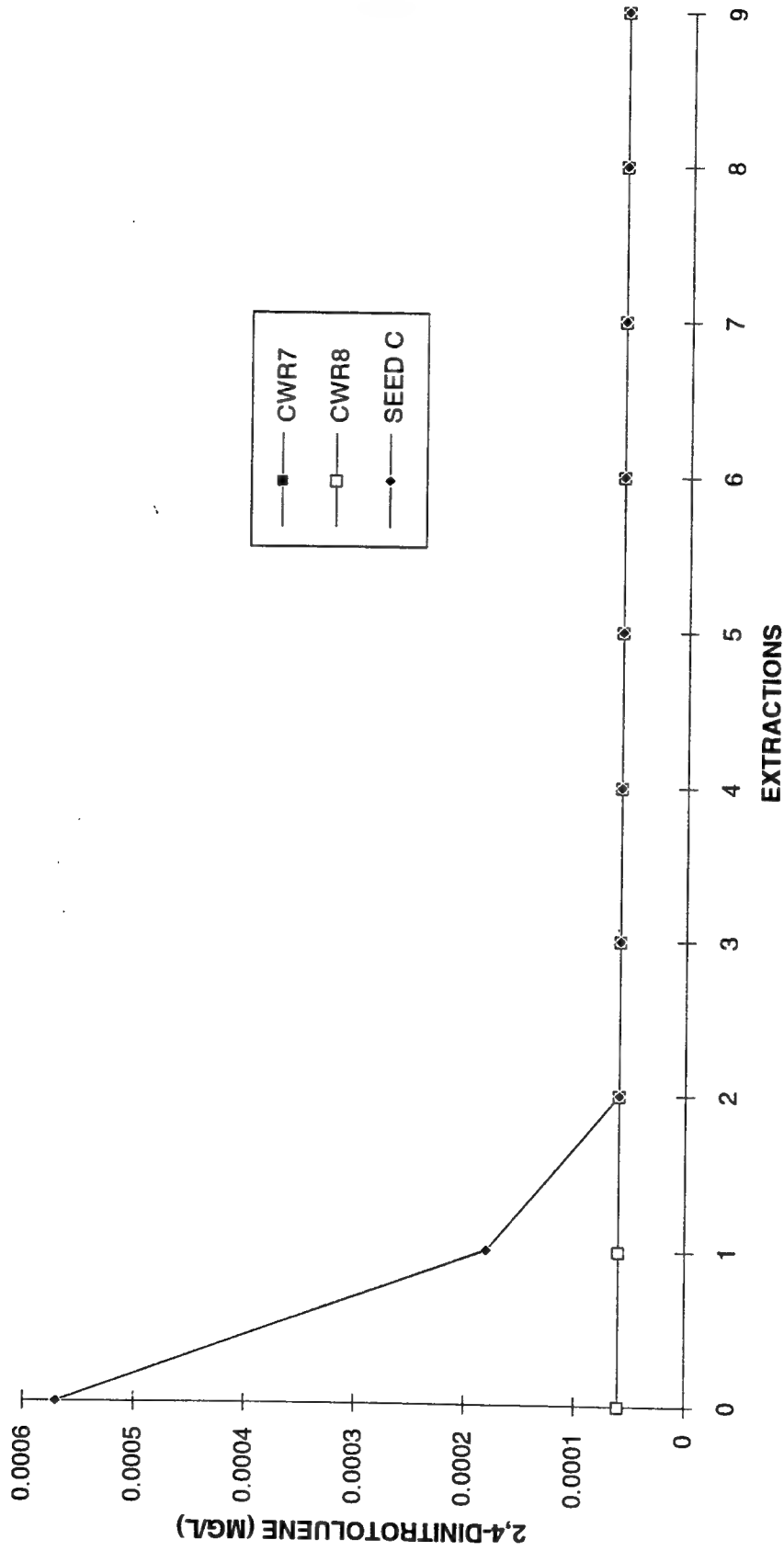


FIGURE 3-6 - 2,4-DINITROTOLUENE RESAMPLING RESULTS

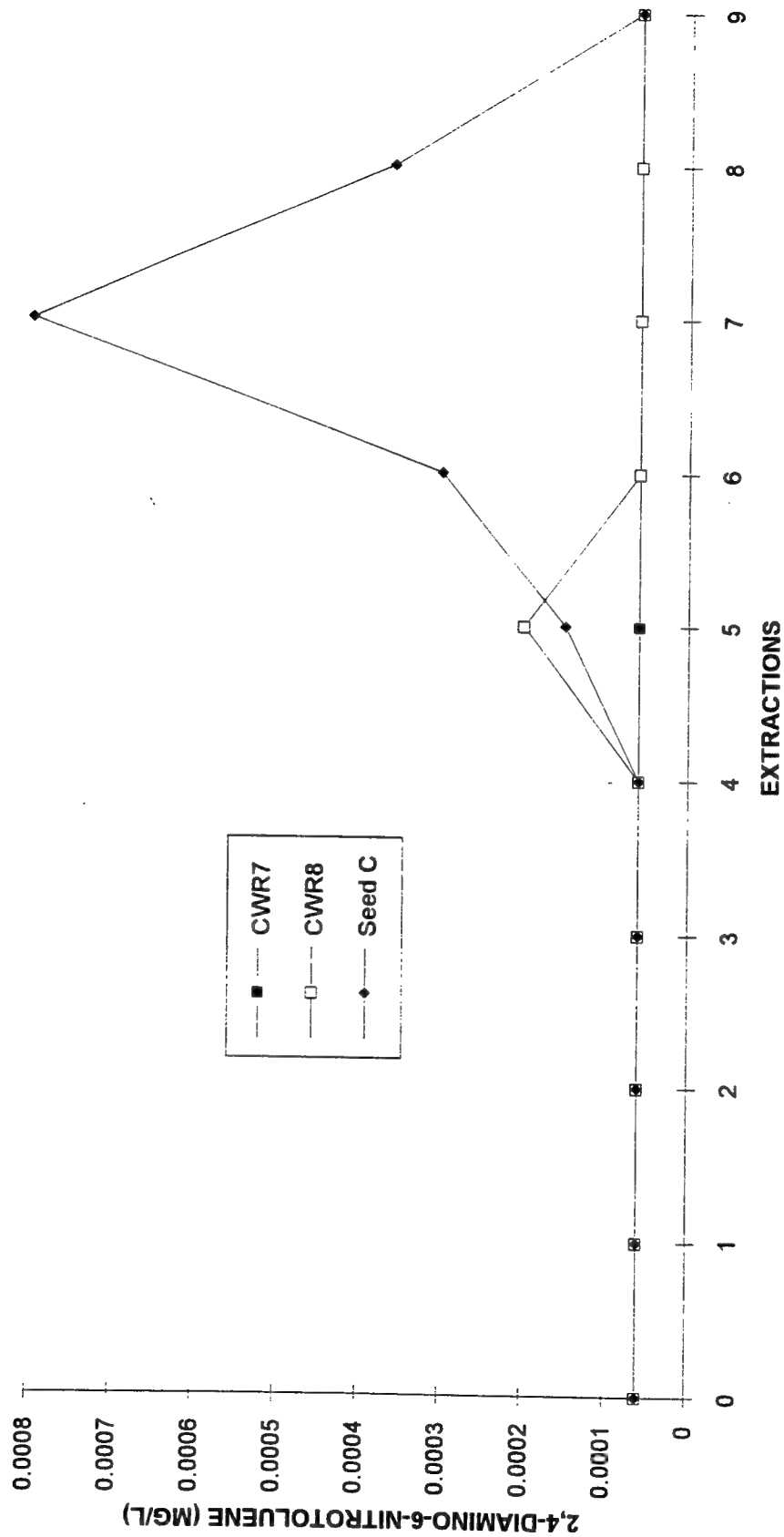


FIGURE 3-7 - 2,4-DIAMINO-6-NITROTOLUENE RESAMPLING RESULTS

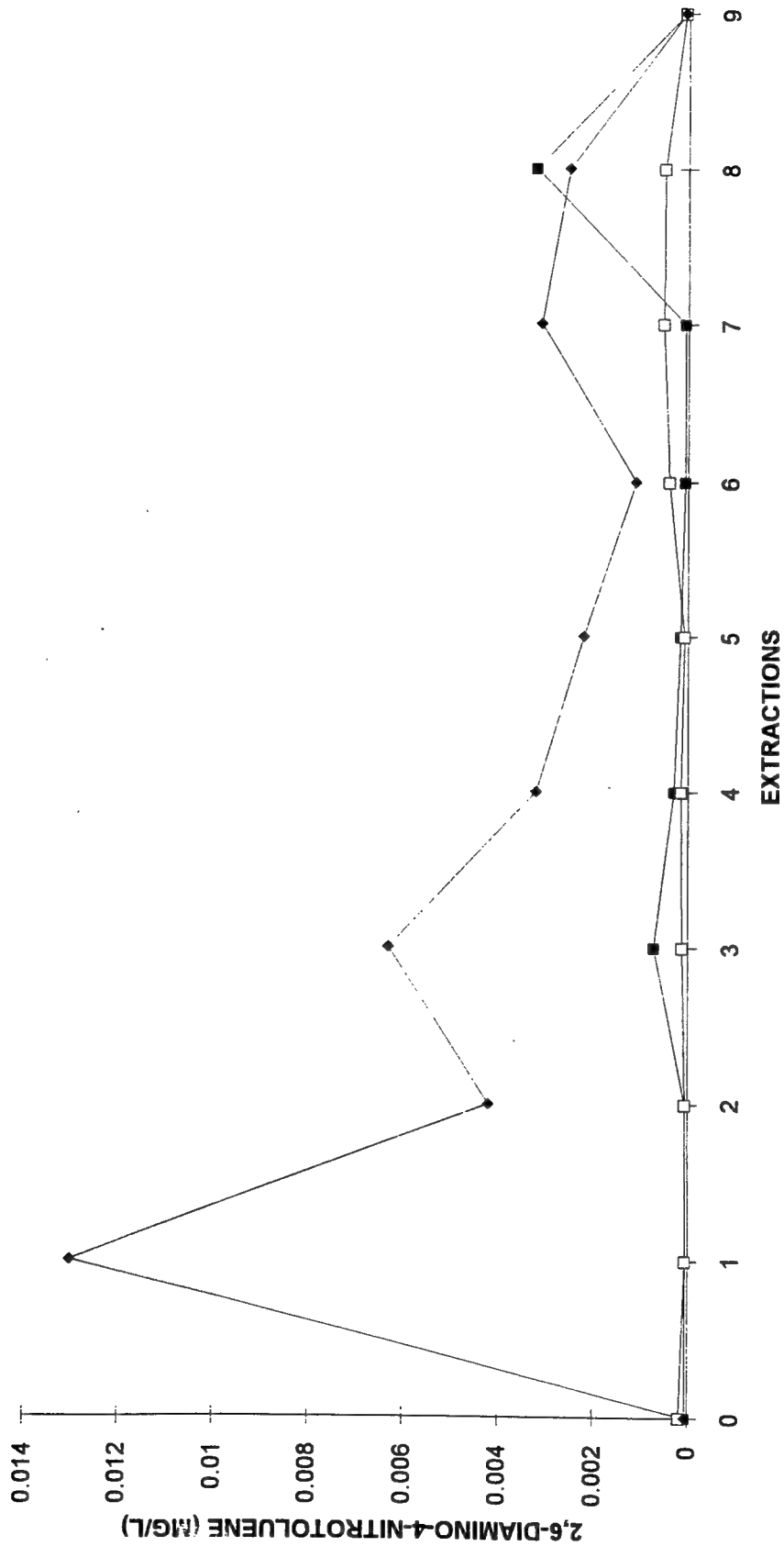


FIGURE 3-8 - 2,6-DIAMINO-4-NITROTOLUENE RESAMPLING RESULTS

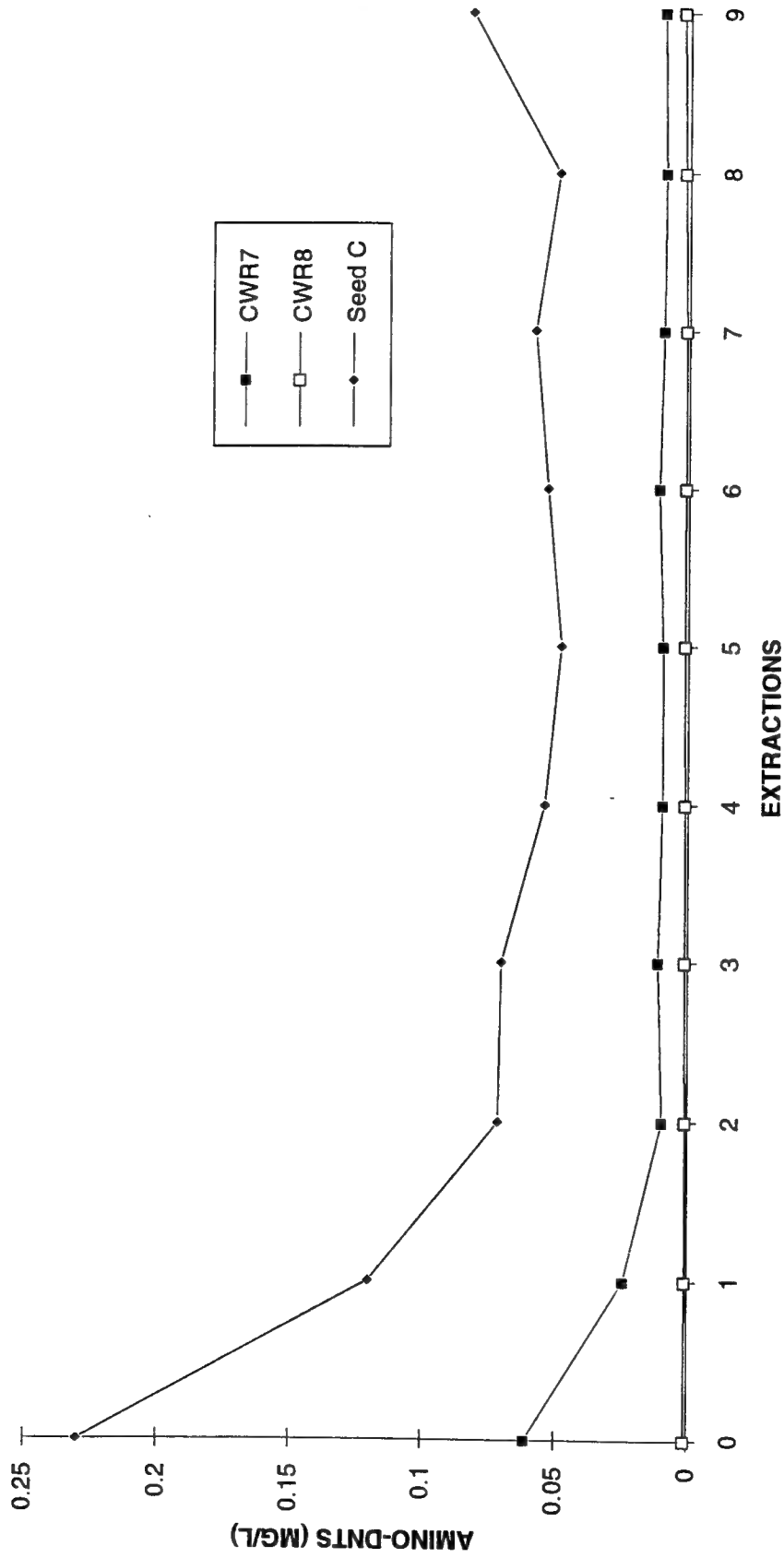


FIGURE 3-9 - AMINO DNT RESAMPLING RESULTS

Table 3-5

Explosives/Intermediates Data
Leachate Comparison

Compound	CRW7 ¹		CRW8 ²	
	Resampling ⁽⁶⁾	Final Day ^(3,4)	Resampling ⁽¹⁶⁾	Final Day ⁽³⁾
2,6-Diamino-4-Nitrotoluene (mg/L)	0.00012 U	<0.25	0.00012 U	<0.154
2,4-Diamino-6-Nitrotoluene (mg/L)	0.00012	<0.25	0.00037	<0.154
Amino-DNTs (mg/L) ⁴	0.061	<0.5	0.0011	<0.308
2,4,6-Trinitrotoluene (mg/kg)	0.00013 U	0.041	0.00051	<0.016
HMX (mg/L)	0.150	0.033	0.0063	<0.24
RDX (mg/L)	1.30	0.589	0.0013	<0.19

¹ Aerated Windrow

² Un-aerated Windrow

³ Data from final day of specified compost test during field demonstration⁽²⁾

⁴ Intermediates analyzed, day 40 of composting; explosives and pH analyzed day 53 of composting. Analysis by SPLP Method.

⁵ Sum of 4-Amino-2,6-Dinitrotoluene and 2-Amino-4,6-Dinitrotoluene.

⁶ Multiple extraction method, initial SPLP extract.

U = Analyzed, Not Detected. Value reported is the minimum detection limit for the sample (not the method detection limit).

Table 3-1 also shows detectable nitrate/nitrite concentrations in the initial leachate for CWR7, CWR8, and Seed C. These data show nitrate-nitrogen levels at or above the 10 mg/L level specified for drinking water under the Safe Drinking Water Act (SDWA). In interpreting these results, it should be recognized that SDWA criteria apply strictly to drinking water from public water supplies at the point of consumption (i.e., at the tap), and are not strictly applicable to discharges to groundwater. However, given the uncertainty associated with nitrate transport in groundwater, regulatory agencies often adopt the 10 mg/L value at the point of discharge to groundwater as a conservative criterion. It is anticipated that the majority of nitrogen released from the finished compost is derived from the nitrogenous components of the amendment mixture rather than from the nitroaromatic/nitramine soil constituents. Based upon the explosives concentrations in the original soils used in CWR7⁽²⁾ and the total nitrogen levels in the initial compost, it is estimated that less than 0.2% of the nitrogen originally present in the compost was attributable to the explosives. It is possible that modified amendment mixtures (with a lower initial nitrogen level) may in part reduce the leaching of nitrate from the finished compost (as long as acceptable C:N values for composting are maintained). Additionally, lower nitrate/nitrite concentrations were found in the unaerated compost than in the aerated compost. This is probably due to less nitrogen conversion to nitrate and/or more ammonia volatilization in the unaerated environment.

CONCLUSIONS

Extractable explosives and intermediates, leachate explosives and intermediates, and extractable nitrate/nitrite were analyzed for samples collected from compost approximately 18 months after the completion of the UMDA demonstration project. Samples were collected from the aerated, contaminated windrow (CWR7); the unaerated, contaminated windrow (CWR8); and seed reactor (Seed C). Low explosives levels were found in all composts. The initial explosives levels were higher for Seed C samples than for the windrow samples. This is in agreement with samples from the final day of composting.

For all three composts analyzed, the extract concentrations, using a modified U.S. EPA Method 1320, were seen generally to decrease with subsequent extractions throughout the nine successive procedures. Nitrate/nitrite concentrations were analyzed only for initial leachate samples. As would be expected for composted organic material, detectable nitrate/nitrite concentrations were present in all samples.

RECOMMENDATIONS

In general, the results of the resampling effort confirm previous work on composting by demonstrating that the extractable or leachable explosives remain low following disposal of the finished compost. Based upon these results, two items may warrant additional consideration in the future:

- Additional work with the Multiple Extraction Procedure to determine whether the apparent increase in analyte concentrations seen in certain tests is reproducible, and
- Evaluation of alternate composting strategies (probably alternate amendment formulas) to reduce the potential for release of nitrate from the final material (which likely occurs from the amendment mixture itself).

SECTION 5

REFERENCES

1. WESTON (Roy F. Weston, Inc.). 1991. Optimization of Composting for Explosives Contaminated Soil, Final Report, prepared for USAEC, Report Number CETHA-TS-CR-91053.
2. WESTON, 1993, Windrow Composting Demonstration for Explosives-Contaminated Soils at the Umatilla Depot Activity, Hermiston, Oregon, Final Report, prepared for USAEC, Report Number CETHA-TS-CR-93043.
3. WESTON. 1988. Field Demonstration—Composting of Explosives-Contaminated Sediments at the Louisiana Army Ammunition Plant (LAAP). Final Report, prepared for USAEC, Report Number AMXTH-IR-TE-8242.
4. Oak Ridge National Laboratories. 1990. Characterization of Explosives Processing Waste Decomposition Due to Composting, prepared for U.S. Army Medical Research and Development Command, Project Order Number 89PP9921.
5. Oak Ridge National Laboratory. April 1993. Characterization of Explosives Processing Waste Decomposition Due to Composting. Preliminary Data, U.S. Army Project Number 89PP9921, Department of Energy number 10-16-123-A1.
6. Amendment of Solicitation/Modification of Contract, Contract no. DACA31-91-D-0079, Task Order 0001, Modification 13, 4 May 1994.
7. WESTON. Addendum to the Test Plan for Additional Sampling at the Umatilla Depot Activity (UMDA), Contract DACA31-91-D-0079, Task Order 01, Work Order Number 02281-012-001.
8. WESTON. 6 April 1994. Addendum to the Health and Safety Plan for Additional Sampling at the Umatilla Depot Activity (UMDA), Contract DACA31-91-D-0079, Task Order 0001, Work Order Number 02281-012-001.
9. WESTON. 1994. Summary Report for Evaluation of Compost Sample Drying Methods. Final Report, prepared for USAEC, Report Number ENAEC-TS-CR-93111.

APPENDIX A

Inter-Office Memorandum



TO: William Lowe

cc: Pete Marks

FROM: John O. Hammell

DATE:

PROJECT:

W.O. NO.:

SUBJECT: Compost Resampling at Umatilla Depot Activity

ACTION:

The following memo summarizes the on-site activities performed at Umatilla Depot Activity (UMDA) by Michael Holpuch and I during the period of 9 May 1994 through 11 May 1994.

Monday, 9 May 1994

- We arrived at UMDA at 2:00 P.M. and proceeded to Building 17 where we confirmed the arrival of the sample bottles and coolers from WESTON Analytics, the personal protection equipment from CES, and the returned washwater, rocks, and compost from the studies performed at ETL. UMDA personnel informed us that shipments addressed to contractors will no longer be accepted at Building 17. In the future, contractors must have their own onsite receiving location at UMDA.
- We borrowed the keys to Building 412 from the main guard house at Building 3. Building 412 is the brick warehouse where all the 55-gallon drums of residues and waste from the RI/FS and composting activities are being stored. Mike and I verified that there was space available for the pails and drums shipped from ETL.
- Next we surveyed the area of the compost storage envelope at the washout lagoons. The excavation contractor had not included the compost storage in his exclusion zone, and access was not a problem.

Tuesday, 10 May 1994

Upon our arrival, Mike and I prepared to conduct the compost resampling. The procedures prescribed by the Test Plan Addendum and the Health and Safety Plan Addendum were

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implemented. Special note is warranted for the following items:

- Prior to removing the plastic cover from the stored compost, the Combustible Gas Indicator was used to monitor the headspace under the cover. Neither a depleted oxygen nor a detectable %LEL were measured.
- The relative positions of the residual composts indicated in the plan view diagram presented in the Test Plan Addendum were confirmed with the exception that the positions of CWR7 and CWR8 appeared to be reversed. This was supported by both a note which Mike Holpuch had written on the internal plastic cover during site demobilization which indicated the positions of the composts, and also by the presence of woodchips in the easternmost compost which is indicative of the aerated windrow (CWR7). As a result, it was determined that the Test Plan Addendum drawing was incorrect, and the samples were taken and labeled appropriately.
- In addition to the composts listed in the Test Plan Addendum, the storage envelop also contains a layer of uncomposted materials. This material is the excess compost that would not fit into the static tanks or MAIV composter when initial mixtures were prepared for studies conducted at the washout lagoons area. As a result, it is likely that this compost mixture contains substantially higher explosives concentrations than the finished composts which we were sampling. This uncomposted material had been placed overtop of the residual composts we were to sample and was separated from them by a plastic sheet. Care was taken during the sampling not to allow these materials to come in contact with the composts below.

Wednesday, 11 May 1994

- Consistent with Larry Werts's memo of 18 March 1994, Mike and I transferred 28 pails of rocks, 6 pails of compost, one 30-gallon steel drum of washwater, and one 55-gallon plastic drum of washwater to Building 412 for storage.
- Mike Holpuch and I confirmed the inventory list and drum map provided by Mike Nelson. We added the pails of rocks and compost, and the drums of washwater to this inventory also.
- Mike and I labeled the final drum of ^{14}C compost with the shipping labels provided by Ron Beethe of Albuquerque. The drum was picked-up by East Oregon Fast Freight for ultimate delivery to the Army for disposal. A shipper's copy of the Bill of Lading was forwarded to Ron Beethe in Albuquerque.